Device for actuating doors of vehicles

The present invention relates to a device for actuating doors of vehicles, in particular aircraft, with a drive element which interworks with a door locking mechanism.

Devices of this type for actuating doors, in particular of aircraft, are known and in standard use on the market in a variety of forms and designs.

Conventionally, aircraft doors are locked by means of mechanical manual locking mechanisms and are often opened manually or, where appropriate, hydraulically.

Hydraulic drive devices of aircraft doors, which automatically open the aircraft doors in an emergency actuation, are also known.

However, manually operable aircraft doors are often locked and swung open, if necessary, via elaborate gearing mechanisms.

It is disadvantageous that devices of this type are, on the whole, elaborate and expensive, difficult to operate and also heavy. These devices are expensive to produce, cannot be remotely activated or remote-controlled, and usually require considerable manual force and time to operate, in particular when opening and/or closing doors of vehicles, in particular aircraft doors.

The object of the present invention is to create a use of the aforementioned type which eliminates the aforementioned disadvantages, and with which doors of vehicles, in particular aircraft, can be locked or opened by remote control in a precise, low-cost and effective manner.

To achieve this object, a stroke movement of a shaft element and subsequent rotation of a carrier element are performed by means of a drive element in an actuation device.

In the present invention, it has proved particularly advantageous to drive an actuation device by means of only one single motor gearing unit, in order to implement first a stroke of a shaft element and then a rotation of a carrier element.

A stroke of a shaft element, which unlocks and lifts a door, is initially performed through axial movement of an actuator element within a housing of the actuation device.

On completion of the stroke of the extended shaft element, a coupling of the rotation with a carrier element is performed via at least one coupling element through a corresponding further rotation of the actuator element, in such a way that, for example, an aircraft door can be swung open via the carrier element. In a corresponding reverse manner, the door, in particular the aircraft door, can be locked through corresponding reverse rotation of the actuator element and reverse movement of the carrier element and, following the locking operation, the aircraft door is returned into the door frame and is simultaneously or subsequently locked through a corresponding return stroke of the shaft element.

The actuator element can be moved axially and rotationally backwards and forwards into the different planes within the housing, in particular the cylinder element of the actuation

device, via corresponding interlocking guide links and link elements. Consideration should also be given to providing the corresponding guide links, for example, in an inner wall of the cylinder element, whereby corresponding guide elements are then assigned to the actuator element and engage with corresponding guide links. The invention is not restricted to this feature.

The present inventive concept also includes the feature that either the actuator element or the housing of the actuation device can be actively driven by means of or via the motor gearing unit. The invention is not restricted to this feature. Both options are conceivable.

The present invention produces a device with which two functions or movements can be performed in a synchronized manner in temporal succession by means of only one single motor gearing unit. An aircraft door, for example, can be unlocked and lifted from a door frame and can then be swung open by the carrier element. The corresponding guide links guarantee that, when the carrier element moves, a return stroke is prevented or ensured. A reverse closing swing of the aircraft door and subsequent insertion and locking of the door can similarly be synchronized with only one single motor gearing unit. By means of the corresponding guide links, these movement operations can be implemented in a

very exact and precise manner by means of only one readily controllable and adjustable device with only one single motor gearing unit.

Further advantages, features and details of the invention are described in the following description of preferred embodiments, and with reference to the drawing, in which:

Figure 1 schematically shows a horizontal projection with a partially cut away longitudinal section through a device for actuating doors, in particular aircraft doors;

Figure 2 schematically shows a partial longitudinal section through the actuation device of the device according to Figure 1 in a position of use;

Figure 3 schematically shows a partial longitudinal section through the actuation device according to Figure 1 in a further position of use.

According to Figure 1, a device R according to the invention for actuating doors of vehicles, in particular aircraft, has a drive element 1 which is designed in the preferred embodiment as a motor gearing unit 2. A gearing unit 4 is connected to a motor 3. The gearing unit 4 or motor gearing unit 2 is connected to an actuation device 5. In the

preferred embodiment, the actuation device 5 has a housing 6 which is preferably designed as a cylinder element 7 with rotational symmetry around a central axis M.

In the area of a front surface 8 of the cylinder element 7, a carrier element 10 is rotatably mounted around the central axis M via at least one bearing 9. The front surface of the carrier element 10 projects slightly beyond the front surface 8 of the cylinder element 7.

A coupling element 12.1, preferably designed as a toothed coupling, is provided on an inner front surface 11.1 of the carrier element. The carrier element 10 and the coupling element 12.1 are preferably designed in an annular form and are provided with a central bore 13.

An actuator element 15 is located with rotational symmetry around the central axis M in the inner space 14 of the housing 6 or the cylinder element 7. The shaft element 16, with rotational symmetry around the axis M, is connected to a front surface 11.2 of the actuator element 15, whereby a further coupling element 12.2, preferably designed as a toothed coupling, is assigned in an annular form to the front surface 11.2.

The shaft element 16 is mounted so that it can slide backwards and forwards axially in the direction X indicated by the double arrows along the central axis M within the bore 13 of the carrier element 10.

The carrier element 10 can be simultaneously moved or slid radially in relation to the shaft element 16.

Guide links 18.1, 18.2 are provided in an outer casing surface 17 of the actuator element 15, whereby the respective guide links 18.1, 18.2 are designed to revolve at least partially around the casing surface 17, interconnecting different planes E1, E2.

A link element 19.1, 19.2 is assigned to an inner wall 20 of the housing G.

The link element 19.1 engages with the guide link 18.1 of the actuator element 15 and the link element 19.2 engages precisely with the guide link 18.2 of the actuator element 15.

The guide links 18.1, 18.2 are at least partially molded into the casing surface 17 of the actuator element 15 so that they can rotate through virtually 360°, whereby said

links interconnect the respective planes E1, E2 of the guide links 18.1 or 18.2 via a pitch 21.

An axial guide 22, which equalizes a stroke H of the actuator element 15 between the carrier element 10 or its coupling elements 12.1, 12.2, is located between the motor gearing unit 2, in particular between the gearing unit 4 and the actuator element 15, as shown in particular in Figure 2. This may, for example, be a splined shaft connection.

The mode of operation of the present invention is as follows:

In the embodiment of the present invention according to Figure 1, a device R is described in which the actuator element 15 can be rotationally driven with the shaft element 16 connected to its front surface by means of the motor gearing unit 2.

In the present embodiment, the motor gearing unit 2 is preferably mounted in a torsion-resistant manner, so that with rotational, active driving of the actuator element 15 around the central axis M through the guide links 18.1, 18.2 described above, which engage with the guide elements 19.1, 19.2, the actuator element 15, as shown in particular in Figure 3, can be moved in the X direction shown against the

carrier element 10. The shaft element 16 is moved by the carrier element 10 through a stroke H.

If the front surfaces 11.1, 11.2 meet with one another when the actuator element 15 moves against the carrier element 10 and if the coupling elements 12.1, 12.2 lie adjacently, coupled with one another, as shown in particular in Figure 2, a radial connection is established between the actuator element 15 and the carrier element 10 in a frictionally or positively engaging manner.

The scope of the invention is also intended to include the feature that the coupling elements 12.1, 12.2 transmit a radial rotation of the actuator element 15 onto the carrier plate 10 in a frictionally or positively engaging manner.

In particular as shown in Figure 2, on completion of the stroke H of the actuator element 15, a subsequent rotation of the carrier element 10 can be synchronized.

An important feature of the present invention is that two functions of the actuator element 15 or the carrier element 10 can be performed in a synchronized manner by means of only one single motor gearing unit 2. The stroke of the shaft element 16 is first performed, until the actuator element 15 meets with the carrier element 10, in order to

then cause the latter, once the stroke is completed, to rotate in accordance with the guide links 18.1, 18.2.

In a corresponding reverse sequence, the carrier element 10 can first be moved back by changing the drive direction of the motor gearing unit 2, and the actuator element 15 with the shaft element 16, as shown from Figure 1 to Figure 3, can then be moved back through a stroke H, in that the actuator element 15 moves from the plane E_1 into the plane E_2 along the guide links 18.1, 18.2. The rotation of the carrier plate 10 is first performed, followed by a return stroke of the shaft element 16 into an original starting position, as shown in Figure 1.

The scope of the present invention is further intended to include the feature that, for example, the motor gearing unit 2 does not rotationally drive the actuator element 5, but rather the housing 6, in particular its cylinder element 7. In this case, the shaft element 16 is fixed to any door in a torsion-resistant manner in relation to the central axis M.

By rotating the housing 6, the actuator element 15 can be moved according to the direction of rotation to produce the stroke H in the X direction shown in Figure 3, until the couplings 12.1, 12.2 frictionally or positively engage and

the carrier element 10 is then rotated around the central axis M. This similarly falls within the scope of the present invention.

Particularly in the case of aircraft doors not shown here, such doors can be unlocked and lifted at very low cost by means of only one single motor gearing unit 2 through a stroke H of the shaft element 16. Once the aircraft door has been unlocked and lifted, the carrier element 10 is rotated around the central axis M through corresponding further radial rotation of the actuator element 15 in order to swing open the aircraft door. The door is closed through a change in direction of the motor gearing unit 2, whereby the door is lowered or inserted and locked by the subsequent return stroke of the shaft element 16.

DR. PETER WEISS & DIPL.-ING. A. BRECHT

Patent Attorneys

European Patent Attorney

File ref.: P 2766/PCT Date: 15.10.02 B/S

Item number list

1	Drive element	34		67	
2	Motor gearing unit	35		68	
3	Motor	36		69	
4	Gearing unit	37		70	
5	Actuation device	38		71	
6	Housing	39		72	
7	Cylinder element	40		73	
8	Front surface	41		74	
9	Bearing	42		75	
10	Carrier element	43		76	
11	Front surface	44		77	
12	Coupling element	45		78	
13	Bore	46		79	
14	Inner space	47			
15	Actuator element	48			
16	Shaft element	49		R	Device
17	Casing surface	50			
18	Guide link	51		M	Central axis
19	Link element	52			
20	Inner wall	53		X	Direction
21	Pitch	54			
22	Axial guide	55		E_1	Plane
23		56		E_2	Plane
24		57			
25		58		H	Stroke
26		59			
27		60			
28		61			
29		62			
30		63			
31		64			
32		65			
33		66			